BIRD ASSEMBLAGES OF PROTECTED AND EXPLOITED COASTAL WOODLANDS IN EAST-CENTRAL ARGENTINA

VICTOR R. CUETO[1,2,3] AND JAVIER LOPEZ DE CASENAVE[2]

ABSTRACT.—We surveyed vegetation and bird assemblages in protected and exploited woodlands in the warm temperate, coastal woodlands of Buenos Aires Province, Argentina. Exploited woodland experienced selective logging of *Celtis tala* until at least 1960; presently it is used for sheltering domestic livestock. Vertical structure and floristic composition were simpler in exploited than in protected woodland. Likewise, avian density and species richness were lower in exploited woodland. Viewing the avifaunas from a guild perspective, we found the insectivore guild and frugivore-insectivore guild differed substantially between protected and exploited woodlands. The bird densities of these guilds were higher in protected woodland, and the species richness of the insectivore guild was lower in the exploited woodland. Apparently the insectivore guild responded primarily to structural differences, whereas the frugivore-insectivore guild may have responded more to differences in floristic composition. The granivore guild also differed between the two woodlands, but primarily because of changes in the density of the Rufous-collared Sparrow (*Zonotrichia capensis*). This bird species was more abundant in the protected woodland. *Received 18 Oct. 1999, accepted 5 March 2000.*

Human modifications of forest structure have different influences on bird communities. Clear-cutting promotes a drastic reduction of density and species richness in bird assemblages inhabiting the forest interior and increases the abundance of birds associated with early successional stages and forest edges (Mannan and Meslow 1984, Probst et al. 1992, Annand and Thompson 1997). In contrast, selective logging has been suggested to have less effect on bird assemblages because this practice may produce smaller changes in vegetative structure (Hansen et al. 1995, Annand and Thompson 1997; but see Franzreb and Ohmart 1978). Domestic livestock also have a negative impact on birds inhabiting woodlands and forests, in part because they decrease understory herbaceous plant cover (Bock et al. 1993, Fleischner 1994). These patterns have been frequently reported for North American bird communities but, as Jaksic and Feinsinger (1991) suggested, North American temperate forests appear to be quite different than their South American counterparts. At the same time, there are few studies on the effects of natural or human habitat alterations on avian assemblages in southern South America (but see, Marone 1990, Willson et al. 1994, Lopez de Casenave et al. 1998, Aleixo 1999).

Coastal woodlands in Buenos Aires Province (east-central Argentina) have suffered considerable degradation because of human activities. Since the end of the eighteenth century, travellers have commented on the exploitation of these woodlands [see Concolocorvo 1773 (1942)]. The main human activities have been the extraction of firewood and charcoal (Cabrera 1949). The woodlands also have been used to shelter domestic livestock (Parodi 1940) or have been eliminated for mining (Parodi 1940). Biogeographical and distributional patterns of the birds of Buenos Aires Province are well known (Narosky and Di Giacomo 1993, Cueto and Lopez de Casenave 1999). The ecology of birds inhabiting the coastal woodlands, however, has been little investigated (but see Cueto 1996).

Here, we report on bird assemblages and vegetation structure in old-growth and second-growth coastal woodlands; the latter are known to have been selectively logged until about 1960 and presently are used for sheltering domestic livestock. We evaluated the following questions: (1) Are there differences between the old-growth and second-growth woodlands in terms of vegetation structure and floristic composition? (2) Are there differences in total bird density and species richness between old-growth and second-growth woodlands? (3) Are there differences in bird

[1] Div. Ornitología, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Avda. Angel Gallardo 470, 1405 Buenos Aires, Argentina.

[2] Depto. de Biología, Facultad de Ciencias Exactas y Naturales, Univ. de Buenos Aires, Piso 4, Pabellón 2, Ciudad Universitaria, 1428 Buenos Aires, Argentina.

[3] Corresponding author; E-mail: vcueto@mastoz.edu.ar

density within trophic guilds between old-growth and second-growth woodlands?

METHODS

Study area.—We conducted the study at the Private Reserve "El Destino" (35° 08' S, 57° 25' W, 2400 ha) on the coast of de la Plata River, Buenos Aires Province, Argentina. This reserve is part of the Biosphere Reserve "Parque Costero del Sur" (26,581 ha; CEPA 1989). Tala-coronillo woodlands occupy 11.4% (ca 274 ha) of the Reserve "El Destino" (Cagnoni et al. 1996). Dominant species of the canopy stratum are *Scutia buxifolia, Celtis tala, Schinus longifolius, Jodina rhombifolia, Sambucus australis,* and *Ligustrum lucidum.* Common species of the shrub stratum are *Pavonia malvacea* and *Sida rhombifolia.* Some vines (*Clematis denticulata, Passiflora coerulea,* and *Parthenocissus quinquefolia*) and an epiphyte (*Tillandsia aeranthos*) grow on the trees and shrubs. The herbaceous stratum is dense and continuous, principally consisting of *Oplismenopsis najada, Parietaria debilis,* and *Euphorbia portulacoides* (Cagnoni et al. 1996).

The climate is wet, warm temperate, with hot summers and mild winters. Frosts are infrequent because of proximity to the river. The mean annual precipitation is 885 mm ($n = 10$ years); the rainiest months are January and February (summer). The mean maximum temperature is 27.5° C and the mean minimum temperature is 5.9° C.

We studied an old-growth tala-coronillo woodland, which has been free of direct human disturbance at least since the beginning of this century (hereafter protected woodland). It is among the few surviving coastal woodlands where the original physiognomy was not altered by forestry practices (Goya et al. 1992). The other woodland was selectively logged for *C. tala* until about 1960 (hereafter exploited woodland). Trees recovered from exploitation mainly by stump sprouting. Today, the exploited woodlands provide shelter for domestic livestock, and the presence of animals appears to reduce the density and extent of the understory. We could not choose our woodlands in a way that controlled for this variable; therefore, any patterns in our data undoubtedly reflect the composite effects of past selective logging and present understory alteration.

Vegetation measurements.—We randomly located eight plots (30 × 30 m) in both protected and exploited woodlands during December 1992 and March 1993. In the center of the plot we established a 15 m transect in each of the four cardinal directions. We sampled vegetation structure at 30 random points on each transect by erecting a rod marked at 1 m intervals at each point and recording the height and species identity of vegetation contacting the rod. The horizontal cover of each tree species was calculated as the percentage of points where the species was present. We averaged values over the four transects for each plot. We depicted profiles of foliage cover as the percentage of points with contacts at 1 m intervals.

Bird surveys.—We sampled bird populations in De-cember 1993 (spring), March 1994 (summer), June 1994 (autumn), and September 1994 (winter) using fixed-radius point counts (Verner 1985, Hutto et al. 1986). Morrison and coworkers (1981) recommended the use of four to six points to obtain a stable estimation of bird density in homogeneous areas (i.e., a single physiognomic class of vegetation dominates the site) such as those in coastal woodlands (Ribichich and Protomastro 1998). Therefore we sampled the bird populations in six randomly located points in each type of woodland. All points were separated from each other at least 150 m. We sampled each point four times for 4 hr or less, beginning 30 min after sunrise, and again during the last 3 hr of daylight. At each point two persons recorded the number of birds seen or heard within 25 m from the center. Using two observers decreased the likelihood of missing birds that were present and improved confidence in species identifications. Sampling began immediately upon arrival at the count area and was continued for 10 min. Birds that flushed from within 25 m upon the observers' arrival were recorded as present (Hutto et al. 1986). We took special precaution to avoid counting the same individual more than once because this is the most important assumption of the method (Verner 1985).

Bird densities were averaged for each sample point over the four counts. We used the bird densities of the 12 spatial replicates (6 in each type of woodland) to avoid temporal pseudoreplication. Species richness per point on each sampling occasion was expressed as the cumulative number of species recorded in the four counts.

Bird species were assigned to three trophic guilds; insectivores, frugivores-insectivores, and granivores based on published data of feeding habits (Short 1975, Canevari et al. 1991, Davis 1993, Montaldo 1993) and observations of foraging behaviors (Cueto 1996; Cueto and Lopez de Casenave, unpubl. data).

Statistical analysis.—We evaluated differences in horizontal plant cover and vegetation profiles between the protected and exploited woodlands with the two-tailed *t*-test or the Mann-Whitney *U*-test when the assumption of normality was violated (D'Agostino-Pearson K^2 test; Zar 1996).

We evaluated differences in bird density, species richness, and guild density between the protected and exploited coastal woodlands by using Two Factor Analysis of Variance with Repeated Measures on One Factor (Winer 1971) because we counted birds in the same points at every season. We used the Tukey multiple comparison test for comparing means and the simple effect test when the interaction between season and woodland was significant (Winer 1971). We tested equality and symmetry of covariance matrices (Winer 1971). Data for frugivore-insectivore guild violated the symmetry assumption, so in this case we used the Greenhouse-Geiser procedure (Lower Bound Epsilon correction, $\epsilon = 0.333$) to adjust the degrees of freedom of within-subject effects (Winer 1971). All statistical analyses were implemented using SPSS/PC+ 4.0 (No-
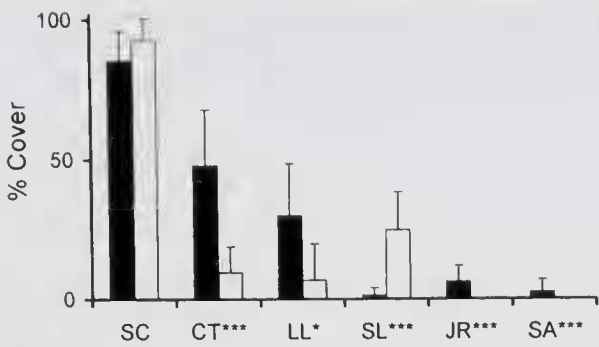
FIG. 1. Mean horizontal coverage (1 SD indicated by vertical line) of tree species in the protected (solid bars) and exploited woodland (open bars) at the Reserve "El Destino", east-central Argentina. Asterisks indicate significant differences between woodlands (two-tailed t-test or Mann-Whitney U-test; $n = 8$; * $P < 0.05$; *** $P < 0.001$). Tree-species acronyms, SC: *Scutia buxifolia*, CT: *Celtis tala*, LL: *Ligustrum lucidum*, SL: *Schinus longifolius*, JR: *Jodina rhombifolia*, and SA: *Sambucus australis*.
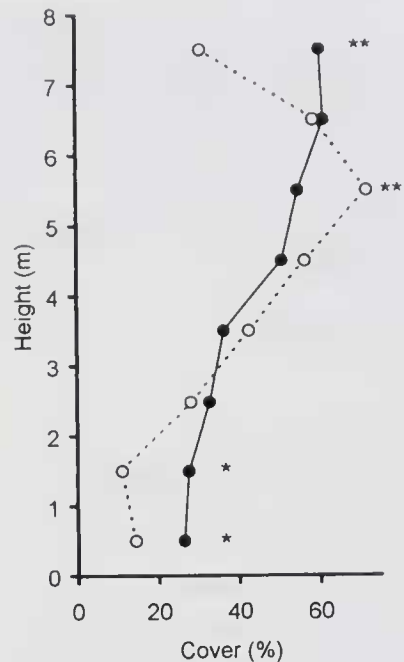

FIG. 2. Mean profiles of foliage cover in the protected (●) and exploited woodland (○) at the Reserve "El Destino", east-central Argentina. Asterisks indicate significant differences between woodlands (two-tailed t-test: $n = 8$; * $P < 0.05$; ** $P < 0.01$).

rusis 1986) for DOS. We used a $P < 0.05$ as our level of accepted significance.

RESULTS

Vegetative structure of woodlands.—The tree species with greatest horizontal cover in the two woodlands was *S. buxifolia*, which did not show differences between the woodlands (Fig. 1). Other species showed important differences in cover between woodlands: *C. tala, L. lucidum, J. rhombifolia,* and *S. australis* had significantly smaller horizontal coverage in the exploited woodland, while *S. longifolia* showed the reverse pattern (Fig. 1).

The vertical distribution of vegetation cover in the protected woodland was relatively uniform between ground and 4 m, then increased slowly, reaching the greatest foliage cover over 7 m (Fig. 2). The undercanopy stratum was principally composed of low trees (e.g., *J. rhombifolia* and *S. australis*) and *L. lucidum* saplings, and the canopy by *S. buxifolia* and *C. tala*. The exploited woodland had less plant cover at low strata (Fig. 2) because undercanopy species present in the protected woodland were missing and there were few *L. Lucidum* saplings. Above 3 m foliage cover increased, peaking at 5–6 m, and then declined rapidly (Fig. 2). The most important species in the canopy of the exploited woodland was *S. buxifolia,* followed by *S. longifolia* and *C. tala*.

Bird assemblages.—Total density of birds in the protected woodland was higher than in the exploited woodland at every season (Table 1, Fig. 3A). In addition, total density showed seasonal changes in both woodlands (Table 1). Seasonal changes were due to differences between spring and autumn densities (Tukey test: $P < 0.01$), principally in the protected woodland (Fig. 3A).

Similar patterns were found in terms of species richness. At every season, bird species richness had greater values in the protected than in the exploited woodland (Table 1, Fig. 3B). Bird species richness varied seasonally in both woodlands (Table 1). Seasonal variations in species richness were due to lower values in autumn (Tukey test: $P < 0.05$), mainly in the protected woodland (Fig. 3b).

Insectivorous bird density in the protected woodland was higher than in the exploited woodland at every season (Table 2, Fig. 4A). The density of this guild did not show seasonal changes in either woodland (Table 2). During spring and summer, we recorded 10 species in the protected woodland, whereas in the exploited only 4 species were found. In autumn and winter the number of species in this guild was similar in both woodlands (Table 3). Tropical Parula (*Parula pitiayumi*), House Wren (*Troglodytes aedon*), Rufous-browed Peppershrike (*Cyclarhis gujanensis*), and Masked Gnatcatcher (*Polioptila dumico-*

TABLE 1. Summary of Two Factor Analysis of Variance with Repeated Measures on One Factor for the total bird density and species richness in the protected and exploited coastal woodlands at the Reserve "El Destino," east-central Argentina. (MS = Mean squared).

Source of variation	df	Total bird density			Species richness		
		MS	F	P	MS	F	P
Between woodlands							
Woodland	1	1913.2	33.5	0.0002	58.5	46.1	0.0001
Point count (woodland)	10	57.1			1.3		
Within woodlands							
Season	3	352.2	3.9	0.02	11.5	3.3	0.04
Season × woodland	3	108.6	1.2	0.3	2.0	0.6	0.6
Season × point count (woodland)	30	91.1			3.5		

la) were the most abundant species of the guild; all of them showed higher densities in the protected woodland (Table 3).

The frugivore-insectivore guild had a higher density in the protected woodland than in the exploited woodland (Table 2) during spring and summer (Fig. 4B). Frugivore-insectivore guild density showed seasonal changes in both woodland types (Table 2). Seasonal changes were the result of higher densities in spring and summer (Tukey test: $P < 0.001$; Fig. 4B). The number of species of this guild was similar in both woodlands and its seasonal changes may be attributed to the arrival of migratory species, such as Small-

billed Elaenia (*Elaenia parvirostris*) and Streaked Flycatcher (*Myiodynastes maculatus*) during spring and summer (Table 3). Frugivore-insectivore guild differences between woodlands in spring were due to the greater abundance of Small-billed Elaenia in the protected woodland, whereas in summer they were due to the higher abundance of Creamy-bellied Thrush (*Turdus amaurochalinus*), Rufous-bellied Thrush (*Turdus rufiventris*), Great Kiskadee (*Pitangus sulphuratus*), and Small-billed Elaenia in the protected woodland (Table 3).

The density of the granivore guild showed an interaction between woodlands and seasons (Table 2). Bird abundance was higher in the protected woodland only in spring and winter (Simple effect test; spring: $F_{1, 30} = 8.35$, $P < 0.01$; winter, $F_{1, 30} = 6.66$, $P < 0.05$; Fig. 4C). Seasonal changes and differences between woodlands largely reflect variation in the density of Rufous-collared Sparrow (*Zonotrichia capensis*; Table 3).

DISCUSSION

We found important effects on bird density and richness, as well as on the densities of the three trophic guilds between protected and exploited woodlands. As our study was carried out in only two woodlands and we could not perform an experimental manipulation, our results did not show directly that logging and domestic livestock have been the cause of such differences. However, based on the woodlands' history and our observations in the surrounding areas, we believe that the differences in avian assemblages are most likely
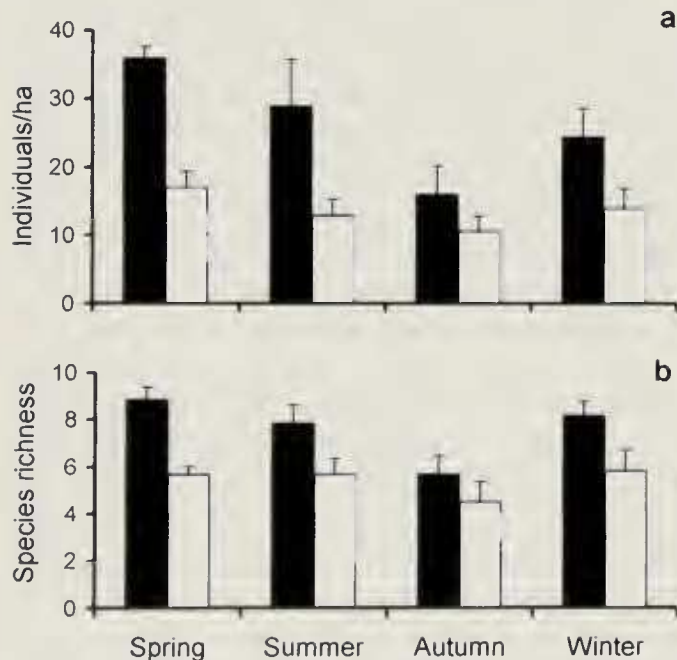

FIG. 3. Mean seasonal variation (1 SE indicated by the vertical line) of the (a) total density of birds and (b) species richness in the protected (solid bars) and exploited woodland (open bars) at the Reserve "El Destino", east-central Argentina.

TABLE 2. Summary of Two Factor Analysis of Variance with Repeated Measures on One Factor for the insectivore, frugivore-insectivore, and granivore guilds in the protected and exploited coastal woodlands at the Reserve "El Destino", east-central Argentina. Probabilities for within woodland effects of the frugivore-insectivore guild have been adjusted with the Lower Bound Epsilon correction ($\epsilon = 0.333$). (MS = Mean squared).

Source of variations	df	Insectivore			Frugivore-insectivore			Granivore		
		MS	F	P	MS	F	P	MS	F	P
Between woodlands										
Woodland	1	494.1	32.0	0.001	160.5	5.5	0.04	81.0	9.0	0.01
Point count (woodland)	10	15.4			29.4			9.0		
Within woodlands										
Season	3	41.7	2.1	0.1	276.0	16.2	0.02	89.8	7.1	0.001
Season × woodland	3	7.5	0.4	0.8	60.8	3.6	0.09	40.0	3.2	0.04
Season × point count (woodland)	30	20.2			17.1			12.7		

related to the woodlands' histories rather than to idiosyncratic or confounding factors.

Unlike some other forests where selective logging appears to affect bird assemblage only weakly (Hansen et al. 1995, Annand and Thompson 1997), we found a strong reduction in both total bird density and species richness in the exploited woodland. This result could
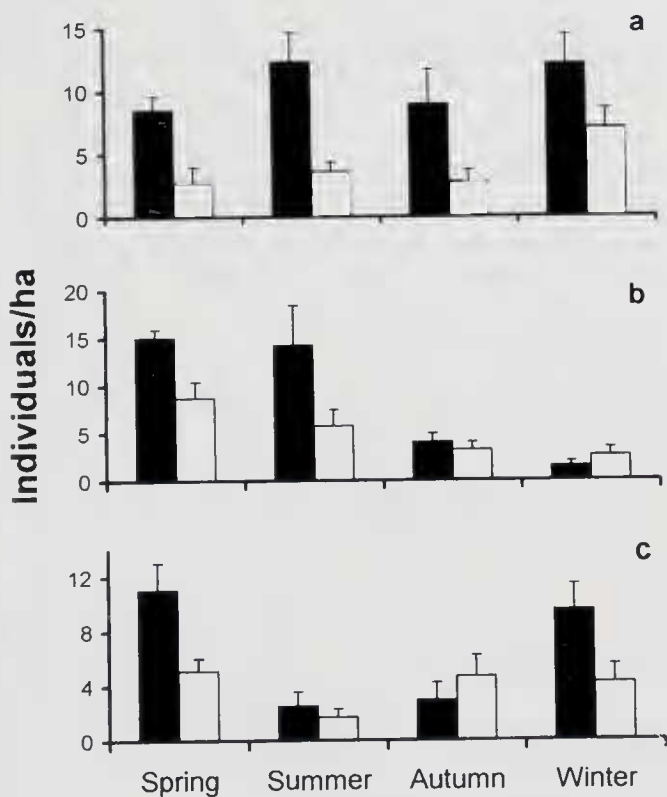

FIG. 4. Mean seasonal changes (1 SE indicated by vertical line) of (a) the density of insectivore, (b) frugivore-insectivore, and (c) granivore guilds in the protected woodland (solid bars) and exploited woodland (open bars) at the Reserve "El Destino", east-central Argentina.

be related to the natural regrowth of the trees. *Celtis tala* has a pronounced capacity for resprouting (Hunziker and Dottori 1976) that appears to be the principal mechanism of tree regeneration, judging by the virtual absence of seedlings and saplings (Ribichich and Protomastro 1998). Resprouting promotes a structure of thin branches and a low canopy. Furthermore, present use of the exploited woodlands by domestic livestock could be responsible for the reduction in cover of some tree species (e.g., *J. rhombifolia, S. australis,* and *L. lucidum*). There is evidence that reduced vertical structure and decreased floristic diversity have a negative impact on bird assemblages (Holmes and Robinson 1981, Rice et al. 1983, Rotenberry 1985).

We found that the abundance and species richness of insectivorous birds were higher in the protected woodland. The bird species of this guild search for food mainly in foliage by gleaning and hovering at different heights (Cueto 1996). In the exploited woodland foliage was dense between 5 and 6 m, but reduced (relative to the protected woodland) at low strata as well as in the top of the canopy. Sparser foliage correlates with lower density and richness of insectivorous birds in other temperate forests (Maurer and Whitmore 1981, Franzreb 1983; but see Darveau et al. 1992).

The density of frugivorous-insectivorous birds varied among seasons in both woodlands, but during spring and summer was higher in the protected than in the exploited woodland. Cueto and Lopez de Casenave (un-

TABLE 3. Trophic guild assignments and density of bird species (individuals/ha) in protected (PW) and exploited (EW) woodlands at "El Destino" Reserve, east-central Argentina. Bird names after Meyer de Schauensee (1970). Guild abbreviations: FI, frugivores-insectivores; G, granivores; I, insectivores.

Species	Spring		Summer		Autumn		Winter	
	PW	EW	PW	EW	PW	EW	PW	EW
Picazuro Pigeon, *Columba picazuro* (G)	1.27	0.43	0.43	1.49	0.85	3.18	1.27	1.70
Eared-dove, *Zenaida auriculata* (G)	—	0.42	0.21	0.21	—	—	—	—
White-tipped Dove, *Leptotila verreauxi* (G)	1.06	0.43	0.21	—	—	0.64	1.27	0.42
Narrow-billed Woodcreeper, *Lepidocolaptes angustirostris* (I)	0.85	—	0.21	—	—	—	0.85	0.21
Tufted Tit-spinetail, *Leptasthenura platensis* (I)	0.21	—	—	—	0.21	—	0.42	—
Sooty-fronted Spinetail, *Synallaxis frontalis* (I)	0.64	—	0.43	—	—	—	—	—
Chicli Spinetail, *Synallaxis spixi* (I)	—	—	0.64	—	0.42	—	2.33	—
Pale-breasted Spinetail, *Synallaxis albescens* (I)	—	—	0.21	—	—	—	—	—
Freckle-breasted Thornbird, *Phacellodomus striaticollis* (I)	0.21	—	—	—	—	—	—	—
Blue-billed Black-tyrant, *Knipolegus cyanirostris* (I)	0.21	0.21	—	0.21	—	—	—	0.21
Streaked Flycatcher, *Myiodynastes maculatus* (FI)	0.42	—	—	0.21	—	—	—	—
Great Kiskadee, *Pitangus sulphuratus* (FI)	0.64	1.70	2.12	1.91	0.43	1.06	0.42	0.85
White-crested Tyrannulet, *Serpophaga subcristata* (I)	0.43	—	0.64	0.42	—	0.21	0.64	0.64
Small-billed Elaenia, *Elaenia parvirostris* (FI)	12.01	3.40	1.91	0.64	—	—	—	—
House Wren, *Troglodytes aedon* (I)	0.85	0.21	3.18	0.42	0.85	1.06	3.40	0.64
Masked Gnatcatcher, *Polioptila dumicola* (I)	0.64	—	1.06	—	2.55	0.42	—	2.12
Rufous-bellied Thrush, *Turdus rufiventris* (FI)	1.06	2.34	5.09	2.34	2.97	2.12	1.06	1.70
Creamy-bellied Thrush, *Turdus amaurochalinus* (FI)	0.85	1.27	5.10	0.64	0.64	—	—	—
Rufous-browed Peppershrike, *Cyclarhis gujanensis* (I)	1.27	0.43	0.21	0.21	2.33	0.85	1.06	0.21
Tropical Parula, *Parula pitiayumi* (I)	3.18	1.91	5.52	2.55	2.12	0.21	3.18	2.55
Golden-crowned Warbler, *Basileuterus culicivorus* (I)	—	—	0.21	—	0.42	0.21	0.21	0.21
Rufous-collared Sparrow, *Zonotrichia capensis* (G)	8.91	3.82	1.70	—	2.12	0.85	7.00	2.12

publ. data) found that seasonal changes in density of this guild were associated with the fruiting patterns of tree species, principally *C. tala, L. lucidum, J. rhombifolia,* and *S. australis.* Differences in density of the frugivorous-insectivorous birds between woodlands during spring and summer (the fruiting seasons; Murriello et al. 1993) could thus be related to differences in the coverage of those plant species that were more abundant in the protected woodland (Fig. 1). Outside the fruiting period (autumn and winter; Murriello et al. 1993), the density of this guild did not differ substantially between woodland types, suggesting that floristic composition was more important than vegetation structure in the habitat used by the frugivorous-insectivorus birds. Other researchers suggest that habitat selection by frugivorous birds correlated closely with fruit availability (e.g., Martin and Karr 1986, Levey 1988, Loiselle and Blake 1993, Rey 1995).

Spatiotemporal variations in the granivore guild as a whole resulted primarily from patterns in one abundant species, Rufous-collared Sparrow. Cueto and Lopez de Casenave (unpubl. data) suggest that seasonal variation in Rufous-collared Sparrow densities reflects the higher food abundance during winter and the greater availability of nesting sites during spring in the coastal woodlands. Our data on Rufous-collared Sparrow in the protected and exploited woodlands support this hypothesis. This species frequently nests on the ground under shrubs, and consumes seeds and litter invertebrates on the ground (Canevari et al. 1991). The exploited woodland provided less cover in the lower strata than the protected woodland; the herbaceous cover was sparse as well. We infer that as a result Rufous-collared Sparrows encountered fewer nesting and foraging opportunities in exploited than in protected woodland. Why the density of this species decreased during summer and autumn in both woodlands was not clear.

Our results indicate that old-growth woodland alterations promoted by past logging and present sheltering of livestock brought about reductions in the abundance and richness of bird assemblages. At present logging effects on birds could be more severe than those reported in this study. New studies are needed to identify the similarities and differences between recently and old logged woodlands and the impact on bird assemblages to determine if our results apply to other Chacoan forests.

LITERATURE CITED

ALEIXO, A. 1999. Effects of selective logging on a bird community in the Brazilian Atlantic forest. Condor 101:537–548.

ANNAND, E. M. AND F. R. THOMPSON, III. 1997. Forest bird response to regeneration practices in central hardwood forests. J. Wildl. Manage. 61:159–171.

BOCK, C. A., V. A. SAAB, T. D. RICH, AND D. S. DOBKIN. 1993. Effects of livestock grazing on Neotropical migrant landbirds in western North America. Pp. 296–309 *in* Status and management of Neotropical migratory birds (D. M. Finch and P. W. Stangel, Tech. coords.). U.S. Dept. of Agriculture, For. Serv. Gen. Tech. Rep. RM-229, Fort Collins, Colorado.

CABRERA, A. L. 1949. Las comunidades vegetales de los alrededores de La Plata. Lilloa 20:269–347.

CABRERA, A. L. AND A. WILLINK. 1980. Biogeografía de América Latina. Organización de Estados Americanos, Washington, D.C.

CAGNONI, M. C., A. M. FAGGI, AND A. M. RIBICHICH. 1996. La vegetación de la Reserva "El Destino" (Partido de Magdalena, Provincia de Buenos Aires). Parodiana 9:25–44.

CANEVARI, M., P. CANEVARI, G. R. CARRIZO, G. HARRIS, J. RODRÍGUEZ MATA, AND R. J. STRANECK. 1991. Nueva guía de las aves argentinas. Fundación Acindar, Buenos Aires, Argentina.

CEPA. 1989. Parque Costero del Sur: naturaleza y cultura pampeana en el mapa del mundo. Centro de Estudios y Proyectos del Ambiente. UNESCO-ORCYT-MAB, Buenos Aires, Argentina.

CONCOLOCORVO. 1773 (1942). El lazarillo de ciegos caminantes desde Buenos Aires hasta Lima. Ediciones Argentinas Solar, Buenos Aires, Argentina.

CUETO, V. R. 1996. Relación entre los ensambles de aves y la estructura de la vegetación. Un análisis a tres escalas espaciales. Ph.D. diss., Univ. de Buenos Aires, Buenos Aires, Argentina.

CUETO, V. R. AND J. LOPEZ DE CASENAVE. 1999. Determinants of bird species richness: role of climate and vegetation structure at a regional scale. J. Biogeogr. 26:487–492.

DARVEAU, M., J. L. DESGRANGES, AND G. GAUTHIER. 1992. Habitat use by three breeding insectivorous

birds in declining maple forests. Condor 94:72–82.

DAVIS, S. E. 1993. Seasonal status, relative abundance, and behavior of the birds of Concepción, Departamento Santa Cruz, Bolivia. Fieldiana: Zool., N.S. 71:1–33.

FLEISCHNER, T. L. 1994. Ecological costs of livestock grazing in western North America. Conserv. Biol. 8:629–644.

FRANZREB, K. E. 1983. A comparison of avian foraging behavior in unlogged and logged mixed-coniferous forest. Wilson Bull. 95:60–76.

FRANZREB, K. E. AND R. D. OHMART. 1978. The effects of timber harvesting on breeding birds in a mixed-coniferous forest. Condor 80:431–441.

GOYA, J., G. PLACCI, M. ARTURI, AND A. BROWN. 1992. Distribución y características estructurales de los Talares de la Reserva de Biosfera "Parque Costero del Sur". Rev. Fac. Agron. la Plata 68:53–64.

HANSEN, A. J., W. C. MCCOMB, R. VEGA, M. G. RAPHAEL, AND M. HUNTER. 1995. Bird habitat relationships in natural and managed forests in the west Cascades of Oregon. Ecol. Appl. 5:555–569.

HOLMES, R. T. AND S. K. ROBINSON. 1981. Tree species preferences of foraging insectivorous birds in a northern hardwood forest. Oecologia 48:31–35.

HUNZIKER, A. T. AND N. M. DOTTORI. 1976. Contribución al conocimiento sobre los talas (*Celtis*, Ulmaceae) de Argentina, con especial referencia a la región mediterránea. I. Sobre una especie austro-sudamericana y sobre otra de área disyunta. Kurtziana 9:103–140.

HUTTO, R. L., S. M. PLETSCHET, AND P. HENDRICKS. 1986. A fixed-radius point count method for nonbreeding and breeding season use. Auk 103:593–602.

JAKSIC, F. M. AND P. FEINSINGER. 1991. Bird assemblages in Temperate forests of North and South America: a comparison of diversity, dynamics, guild structure, and resource use. Rev. Chil. Hist. Nat. 64:491–510.

LEVEY, D. J. 1988. Spatial and temporal variation in Costa Rican fruit and fruit-eating bird abundance. Ecol. Monogr. 58:251–269.

LOISELLE, B. A. AND J. G. BLAKE. 1993. Spatial distribution of understory fruit-eating birds and fruiting plants in Neotropical lowland wet forest. Vegetatio 107/108:177–189.

LOPEZ DE CASENAVE, J., J. P. PELOTTO, S. M. CAZIANI, M. MERMOZ, AND J. PROTOMASTRO. 1998. Responses of avian assemblages to a natural edge in a Chaco semi-arid forest, Argentina. Auk 115:425–435.

MANNAN, R. W. AND E. C. MESLOW. 1984. Bird populations and vegetation characteristics in managed and old-growth forests, northeastern Oregon. J. Wildl. Manage. 48:1219–1238.

MARONE, L. 1990. Modification of local and regional

bird diversity after a fire in the Monte desert, Argentina. Rev. Chil. Hist. Nat. 63:187–195.

MARTIN, T. E. AND J. R. KARR. 1986. Temporal dynamics of Neotropical birds with special reference to frugivores in second-growth woods. Wilson Bull. 98:38–60.

MAURER, B. A. AND R. C. WHITMORE. 1981. Foraging of five bird species in two forests with different vegetation structure. Wilson Bull. 93:478–490.

MEYER DE SCHAUENSEE, R. 1970. A guide to the birds of South America. Livingston Publishing Company, Wynnewood, Pennsylvania.

MONTALDO, N. H. 1993. Dispersión por aves y éxito reproductivo de dos especies de *Ligustrum* (Oleaceae) en un relicto de selva subtropical en la Argentina. Rev. Chil. Hist. Nat. 66:77–85.

MORRISON, M. L., R. W. MANNAN, AND G. L. DORSEY. 1981. Effects of number of circular plots on estimates of avian density and species richness. Stud. Avian Biol. 6:405–407.

MURRIELLO, S., M. ARTURI, AND A. D. BROWN. 1993. Fenología de las especies arbóreas de los talares del este de la Provincia de Buenos Aires. Ecol. Austral 3:25–31.

NORUSIS, M. J. 1986. SPSS/PC+ advanced statistics. SPSS, Inc, Chicago, Illinois.

PARODI, L. R. 1940. La distribución geográfica de los talares en la Provincia de Buenos Aires. Darwiniana 4:33–56.

PROBST, J. R., D. S. RAKSTAD, AND D. J. RUGG. 1992. Breeding bird communities in regenerating and mature broadleaf forests in the USA Lake States. For. Ecol. Manage. 49:43–60.

REY, P. J. 1995. Spatio-temporal variation in fruit and frugivorous bird abundance in olive orchards. Ecology 76:1625–1635.

RIBICHICH, A. M. AND J. PROTOMASTRO. 1998. Woody vegetation structure of xeric forest stands under different edaphic site conditions and disturbance histories in the Biosphere Reserve 'Parque Costero del Sur', Argentina. Plant Ecol. 139:189–201.

RICE, J., R. D. OHMART, AND B. W. ANDERSON. 1983. Habitat selection attributes of an avian community: a discriminant analysis approach. Ecol. Monogr. 53:263–290.

ROTENBERRY, J. T. 1985. The role of habitat in avian community composition: physiognomy or floristics? Oecologia 67:213–217.

SHORT, L. L. 1975. A zoogeographic analysis of the South American Chaco avifauna. Bull. Am. Mus. Nat. Hist. 154:163–352.

VERNER, J. 1985. Assessment of counting techniques. Curr. Ornithol. 2:247–302.

WILLSON, M. F., T. L. DE SANTO, C. SABAG, AND J. J. ARMESTO. 1994. Avian communities of fragmented south-temperate rainforests in Chile. Conserv. Biol. 8:508–520.

WINER, B. J. 1971. Statistical principles in experimental design, second ed. McGraw-Hill Kogakusha, Ltd., Tokyo, Japan.

ZAR, J. H. 1996. Biostatistical analysis, third ed. Prentice Hall, Upper Saddle River, New Jersey.